WSR-88D Build 10 Overview for NIDS Users

Presented by the
WSR-88D OSF Operations Training Branch

Version: 9812

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On the Cover

Tornado picture taken by Scott Woelm near Eldridge, North Dakota.
August 31, 1997.

This document is available online at:

http://www.osf.noaa.gov/otb/build10/

New Algorithms / Products

New Tornado Detection Algorithm (TDA) / TVS Product

Introduction

Build 10 introduces a new Tornado Detection Algorithm (TDA) which is replacing the current Tornadic Vortex Signature (TVS) Detection Algorithm. Although the algorithm name is changing from TVS to TDA, the WSR-88D product will continue to be called Tornadic Vortex Signature (mnemonic TVS, ID# 61).

NOTE: The TVS product is ***NOT*** available to NIDS. However, since output from the algorithm is available via the composite reflectivity attribute table, a discussion of the TDA is provided as background information.

The Build 9 TVS algorithm is not very robust, and was designed to be a place holder until a better algorithm could be put in place. As a result, performance of the current TVS algorithm is poor, with a low probability of detection, limited adaptable parameters, no discrimination between tornadic and non-tornadic shears, and no requirement for shear to be gate-to-gate. Once in a great while, when the TVS algorithm triggered, it mostly confirmed tornadic events that had already occurred.

The Tornado Detection Algorithm (TDA) was developed at the **National Severe Storms Laboratory (NSSL)** and is designed to detect significant shear regions in the atmosphere. The TDA uses multiple velocity thresholds to locate shear regions, and classifies these regions according to altitude and strength. The WSR-88D TVS product in Build 10 displays more operationally pertinent information, and a new graphic symbol. Performance of the TDA is better than TVS, with a higher probability of detection, many adaptable parameters, some discrimination between tornadic and non-tornadic shear, and a requirement for gate-to-gate shear. TDA can provide positive lead times for storms that become tornadic.

Build 9 TVS Detection Algorithm - A Review

The Build 9 TVS and mesocyclone algorithms work together, and in fact, the bulk of the velocity analysis for TVS is actually performed by the mesocyclone algorithm. The mesocyclone algorithm processes velocity data and identifies 3-D circulations. If a mesocyclone is found, the TVS algorithm performs shear calculations within that circulation to determine if a Tornadic Vortex Signature also exists. ***In Build 9 software, a TVS cannot exist without an algorithm-identified mesocyclone.***

The ***mesocyclone*** algorithm builds circulations in a multi-step process. First, a pattern vector is identified by searching for a series of azimuthally adja-

Pattern Vector
(A run of increasing velocities)

RANGE	rad #1	rad#2	rad#3	rad#4	rad#5	rad#6	rad#7
33.00km	-7	-10	-10	-7	1	2	1
32.75km	-10	-15	-13	-11	4	3	0
32.50km	-4	-11	-14	-18	12	22	13
32.25km	-11	-19	-22	13	18	11	-1
32.00km	-4	-9	-19	3	18	17	12
31.75km	-10	-14	-22	1	21	9	9
31.50km	-10	-25	-19	-6	6	2	1
31.25km	-7	-3	-5	-6	7	13	10
31.00km	-1	2	1	-3	-4	-4	-6

RDA

Figure 1. Runs of increasing velocity are highlighted in blue. Note the relative position of the RDA at the bottom of the table.

cent range bins with increasing Doppler velocity on an elevation slice (see Fig. 1). (All algorithm processing occurs clockwise, or with increasing azimuth, which implies that only cyclonic features are detected). Pattern vector velocity values must satisfy momentum and shear criteria. If these criteria are not met, the pattern vector is discarded (see Fig. 2).

Next, pattern vectors in close proximity to one another are combined to form 2-D features. Whether or not pattern vectors become associated with the same 2-D feature depends on their azimuthal and radial distance from one another. The RPG adaptable parameter Threshold Pattern Vector, TPV, determines the minimum number of pattern vectors required (default 10) for a 2-D feature to be identified (see Fig. 3).

Finally, 2-D features are vertically correlated to form 3-D circulations. Ideally, all 2-D features in the same 3-D circulation lie on adjacent elevation angles. However, the software permits one missing elevation angle between features to allow for

Pattern Vector
(A run of increasing velocities)

RADIAL	rad #1	rad#2	rad#3	rad#4	rad#5	rad#6	rad#7
33.00km	-7	-10	-10	-7	1	2	1
32.75km	-10	-15	-13	-11	4	3	0
32.50km	-4	-11	-14	-18	12	22	13
32.25km	-11	-19	-22	13	18	11	-1
32.00km	-4	-9	-19	3	18	17	12
31.75km	-10	-14	-22	1	21	9	9
31.50km	-10	-25	-19	-6	6	2	1
31.25km	-7	-3	-5	-6	7	13	10
31.00km	-1	2	1	-3	-4	-4	-6

RDA

Figure 2. Pattern vectors in green did not satisfy momentum and shear criteria.

2-D Feature
(Only if number of pattern vectors exceed TPV)

RADIAL	rad #1	rad#2	rad#3	rad#4	rad#5	rad#6	rad#7
33.00km	-7	-10	-10	-7	1	2	1
32.75km	-10	-15	-13	-11	4	3	0
32.50km	-4	-11	-14	-18	12	22	13
32.25km	-11	-19	-22	13	18	11	-1
32.00km	-4	-9	-19	3	18	17	12
31.75km	-10	-14	-22	1	21	9	9
31.50km	-10	-25	-19	-6	6	2	1
31.25km	-7	-3	-5	-6	7	13	10
31.00km	-1	2	1	-3	-4	-4	-6

Figure 3. 2-D feature is outlined.

dealiasing and range folding problems (see Fig. 4). Circulations are labeled as Mesocyclones when the circulation meets an aspect ratio of a given length to width (adaptable parameter). Otherwise, circulations are labeled as 3-D Correlated Shear.

The Build 9 ***TVS*** algorithm is initiated once the mesocyclone algorithm detects a mesocyclone. For each 2-D feature within the mesocyclone, the area is expanded by the amount specified by PCT (search percentage, default 5%), then searched

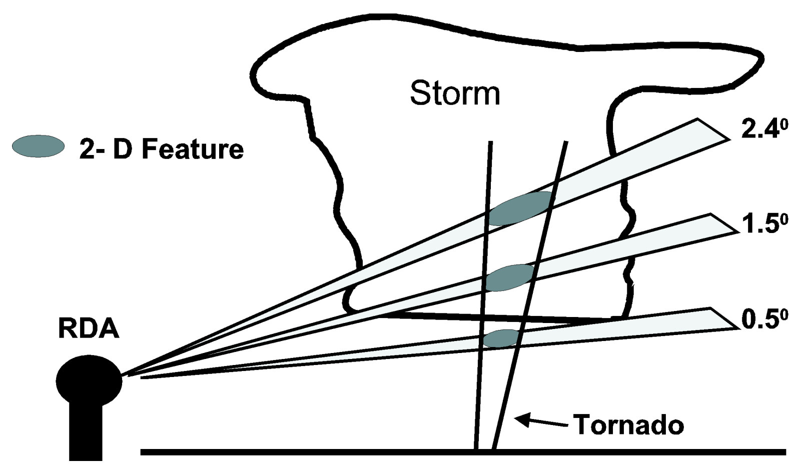


Figure 4. Vertically correlated 2-D features.

2-D Feature Velocity Extremes
(Can be radially / azimuthally separated)

RADIAL	rad #1	rad#2	rad#3	rad#4	rad#5	rad#6	rad#7
33.00km	-7	-10	-10	-7	1	2	1
32.75km	-10	-15	-13	-11	4	3	0
32.50km	-4	-11	-14	-18	12	22	13
32.25km	-11	-19	-22	13	18	11	-1
32.00km	-4	-9	-19	3	18	17	12
31.75km	-10	-14	-22	1	21	9	9
31.50km	-10	-25	-19	-6	6	2	1
31.25km	-7	-3	-5	-6	7	13	10
31.00km	-1	2	1	-3	-4	-4	-6

RDA

Figure 5. Red and green values used in TVS shear calculation.

for ***minimum-maximum velocities***, and a shear value is calculated (see Fig. 5). If a threshold shear value is reached on at least 2 elevations within the mesocyclone, a TVS is declared. ***Note that TVS shear need not be gate-to-gate.*** The RPG adaptable parameter TVS Threshold Shear, TTS, allows the operator to control algorithm performance by changing TVS shear criteria.

Build 10 Tornado Detection Algorithm

In Build 10, the Mesocyclone and Tornado Detection algorithms process data separately. This means that ***an algorithm-identified mesocyclone need not exist for a TVS or Elevated TVS (ETVS) to be identified.*** The TDA is modeled after the SCIT algorithm and uses a three step process to identify circulations.

First, 1-D pattern vectors are identified on each elevation slice. In TDA, a pattern vector is a region of gate-to-gate shear, which means the velocity difference is calculated between range bins ***located on adjacent azimuths*** at the same range. A minimum shear value is required for a pattern vector to be identified (see Fig. 6). The TDA searches only for patterns of velocity indicat-

1-D Pattern Vector
(Shear Segment)

RADIAL	rad #1	rad#2	rad#3	rad#4	rad#5	rad#6	rad#7
33.00km	-7	-10	-10	-7	1	2	1
32.75km	-10	-15	-13	-11	4	3	0
32.50km	-4	-11	-14	-18	12	22	13
32.25km	-11	-19	-22	13	18	11	-1
32.00km	-4	-9	-19	3	18	17	12
31.75km	-10	-14	-22	1	21	9	9
31.50km	-10	-25	-19	-6	6	2	1
31.25km	-7	-3	-5	-6	7	13	10
31.00km	-1	2	1	-3	-4	-4	-6

RDA

Figure 6. TDA pattern vectors shown in pink. For reference, mesocyclone pattern vectors are shown in blue.

ing cyclonic rotation. It ***does not*** detect an anticyclonically rotating tornadic signature.

Next, 2-D features are created by combining the 1-D pattern vectors (see Fig. 7). At least three pattern vectors (default) are needed to declare a 2-D feature. TDA uses six velocity difference thresholds to identify pattern vectors. This technique allows the algorithm to isolate core circulations which may be embedded within regions of long azimuthal shear. An example would be a radially

2-D Features
(Combine 1-D Pattern Vectors and Trim)

RANGE	rad #1	rad#2	rad#3	rad#4	rad#5	rad#6	rad#7
33.00km	-7	-10	-10	-7	1	2	1
32.75km	-10	-15	-13	-11	4	3	0
32.50km	-4	-11	-14	-18	12	22	13
32.25km	-11	-19	-22	13	18	11	-1
32.00km	-4	-9	-19	3	18	17	12
31.75km	-10	-14	-22	1	21	9	9
31.50km	-10	-25	-19	-6	6	2	1
31.25km	-7	-3	-5	-6	7	13	10
31.00km	-1	2	1	-3	-4	-4	-6

RDA

Figure 7. TDA 2-D feature outlined in black.

oriented gust front or squall line. In Figure 8, a long segment of shear exceeding 15 m/s has embedded within it a smaller segment of shear greater than 20 m/s, and still smaller segments of shear greater than 25 m/s. If a 2-D feature passes a symmetry test (length to width ratio within a specified limit), it is declared a 2-D circulation.

2-D Features

Multiple thresholds and embedded shears

		rad #1	rad #2	
		-9	8	
		-13	14	25 m/s
	20 m/s	-12	11	
		-15	10	25 m/s
15 m/s		-7	8	
		-6	13	
		-14	15	
	20 m/s	-13	16	25 m/s
		-12	11	
		-6	9	

Figure 8. Multiple velocity thresholds used to identify stronger shear embedded within weaker shear.

Finally, 3-D features are created by vertically correlating the 2-D circulations identified at each elevation (see Fig. 9). Processing begins by correlating the strongest 2-D circulations first, then moving to progressively weaker circulations. If a feature contains at least three vertically correlated 2-D circulations, it is declared a 3-D circulation, and identified as either a TVS or an ETVS. Ideally, there will be no gaps in elevation angles between the vertically correlated 2-D circulations. However, a one elevation angle gap is permitted to account for base data problems such as range folding and velocity dealiasing failures.

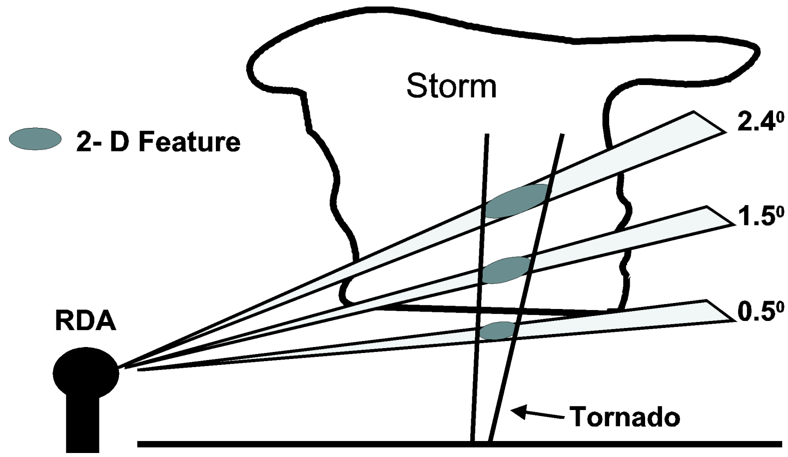


Figure 9. Vertically correlated 2-D circulations.

TDA vs. TVS Shear Calculation

A comparison of Build 10 TDA and Build 9 TVS indicates one weakness of the TVS algorithm. In Build 9, intense shear may exist gate-to-gate, but if larger values of inbound and outbound velocity exist elsewhere in the feature, shear will be calculated using those velocity values, and not the gate-to-gate velocity values (see Fig. 10). Recall that shear is defined as the velocity difference divided by the distance between the velocity values. In this case, the large separation of the strongest velocity values results in the TVS algorithm having a shear about 1/3 as large as the gate-to-gate TDA shear, even though the velocity values used in calculating TVS shear are larger.

Some tornadoes have been observed in circulations in which the gate-to-gate shear was weak, but a 3-D velocity feature caused the Build 9 TVS algorithm to trigger. This resulted in the TVS algorithm outperforming the Build 10 TDA. This apparently occurs only rarely.

TVS Shear vs. TDA Shear

RANGE	rad #1	rad#2	rad#3	rad#4	rad#5	rad#6	rad#7
	TDA Shear = 35kt/0.5 nm =70/hr						
			-14	-18	12	22	
			-22	13	18		
30 nm			-19	3	18		
			-22	1	21		
		-25					
		TVS Shear = 47kt/2.0nm=23.5/hr					
	RDA						

Figure 10. Calculation of TVS shear vs. TDA shear.

Definitions and Symbology

The Build 10 Tornado Detection Algorithm conducts a more thorough analysis of the velocity data as compared to Build 9 TVS Detection Algorithm. This gives operators more pertinent information about the structure and strength of possible tornadic circulations. In addition to a new TVS definition, an Elevated TVS definition has been added. The parameter values given in the following definitions for TVS and ETVS are the Build 10 default values.

TVS

A Tornadic Vortex Signature, TVS, is defined as a 3-D circulation with a base located on the 0.5° slice ***or*** below 600 meters ARL (above radar level). The depth of the circulation must be at least 1.5 km. Additionally, the maximum delta velocity anywhere in the circulation must be at least 36 m/s, or at least 25 m/s at the base of the circulation. The TVS symbol is displayed on the graphic product and overlay as a red, filled, inverted triangle, slightly larger than the Build 9 symbol. TVS symbols are placed at the azimuth and range of the lowest 2-D feature.

ETVS

An Elevated Tornadic Vortex Signature, Elevated TVS or ETVS, is defined as a 3-D circulation with a base above the 0.5° slice ***and*** above 600 meters ARL. The depth of the circulation must be at least 1.5 km. Additionally, the delta velocity at the base of the circulation must be at least 25 m/s. The ETVS symbol is displayed on the TVS overlay and the TVS graphic product as a red, open, inverted triangle as shown in Figure 11, and is placed at the azimuth and range of the lowest 2-D feature.

The default values listed above for depth, delta velocity at the base of the circulation, maximum delta velocity anywhere in the circulation, and height above radar are only ***some*** of the TDA adaptable parameters.

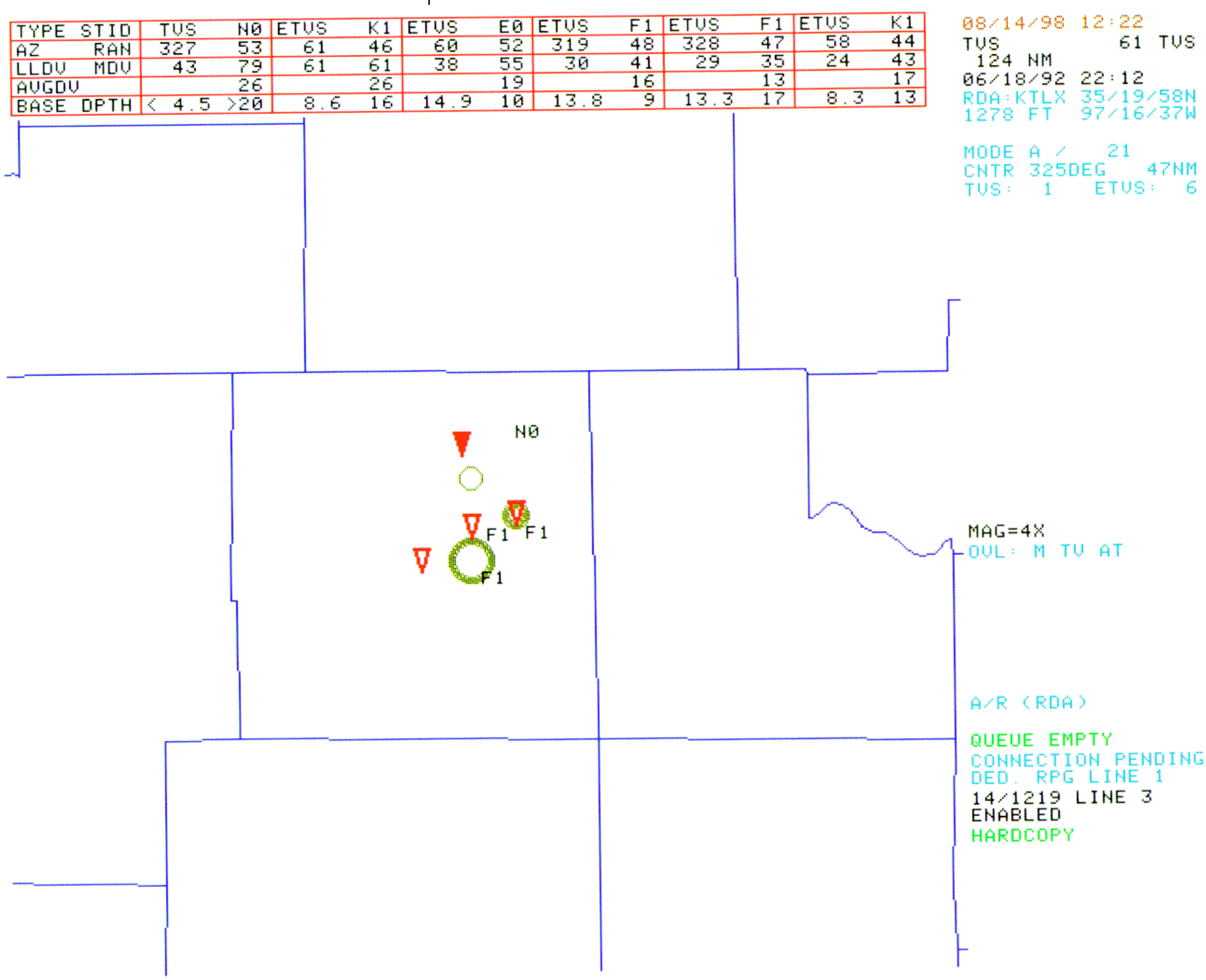


Figure 11. Example of the Build 10 TVS graphic product. This product is ***NOT*** available to NIDS. However, some of the attributes are available via the CR product.

Note that an Elevated TVS may possess a larger value of maximum shear somewhere in the storm column as compared to a TVS, but if there is no circulation on the 0.5° slice or below 600 meters, it cannot be defined as a TVS, despite possessing the higher shear.

Combined Attribute Table

The information from the Mesocyclone and Tornado Detection algorithms is output to the Combined Attribute Table (CAT) as well as other graphic and alphanumeric products. In Build 9, the entries in the CAT for both the TVS and MESO columns were either YES or NO. In Build 10, this table will display types of circulations identified by the algorithms (see Fig. 12). In the TVS column, the Combined Attribute Table will now state one of the following:

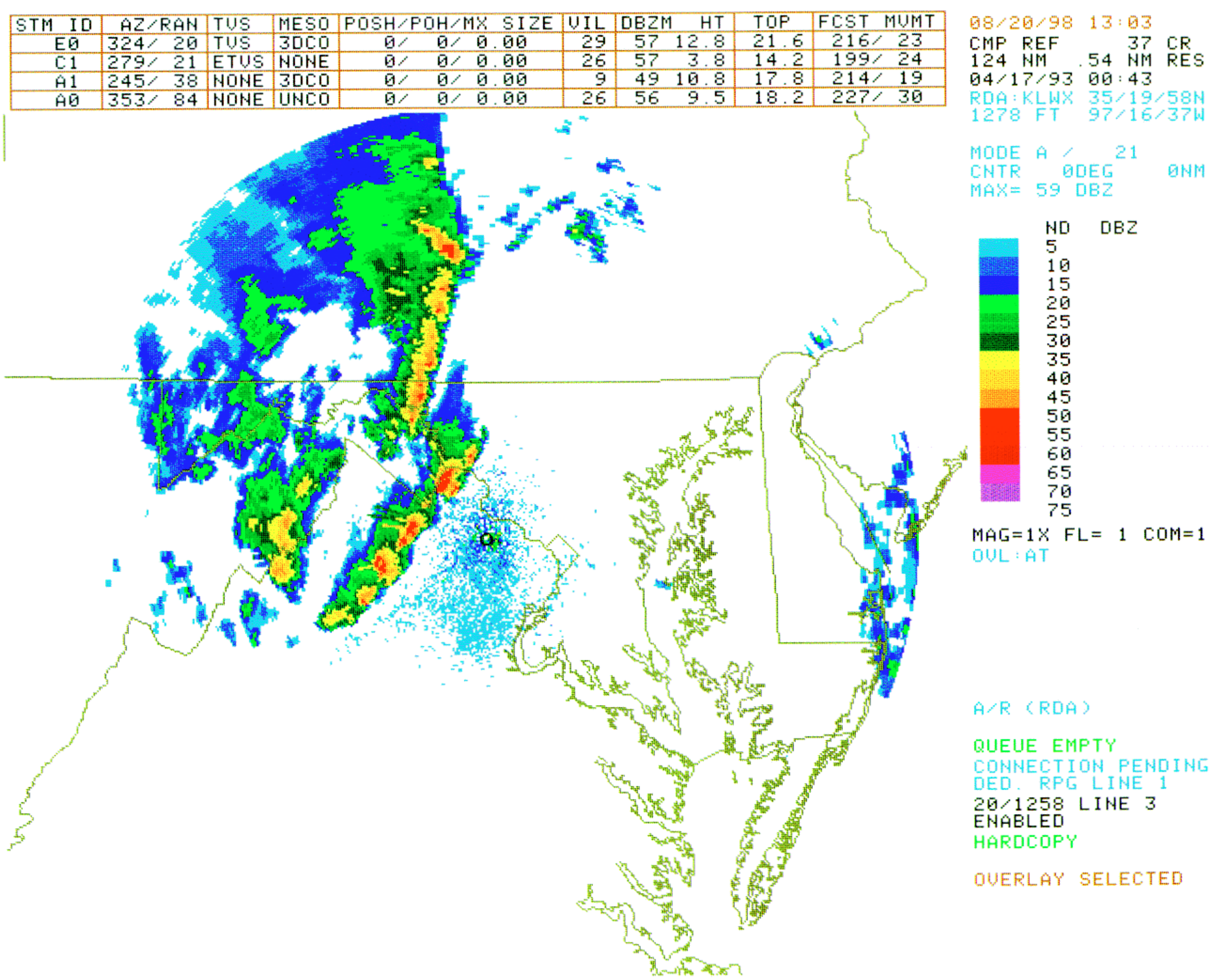
TVS	Tornadic Vortex Signature identified
ETVS	Elevated Tornadic Vortex Signature identified
NONE	No TVS or ETVS identified

In the MESO column, the Combined Attribute Table will now state one of the following:

MESO	Mesocyclone identified
3DCO	3-D Correlated Shear identified
UNCO	Uncorrelated Shear (2-D) identified
NONE	No Meso, 3-D shear or 2-D shear identified

TDA Adaptable Parameter Sets

The Tornado Detection Algorithm contains 30 adaptable parameters as compared to only two for the TVS Detection Algorithm. The default values for TDA were derived from analyzing algorithm performance while using a large, geographically diverse data set. The OSF recognizes that the default values assigned to the TDA will not work well in all regions of the country and for all weather situations. Therefore, the OSF has delegated authority for changing some of these values to the Unit Radar Committee (URC) level in the form of parameter sets. Currently, there are four parameter sets from which to choose:



STM ID	AZ/RAN	TVS	MESO	POSH/POH/MX SIZE	VIL	DBZM HT	TOP	FCST MVMT
E0	324/ 20	TVS	3DCO	0/ 0/ 0.00	29	57 12.8	21.6	216/ 23
C1	279/ 21	ETVS	NONE	0/ 0/ 0.00	26	57 3.8	14.2	199/ 24
A1	245/ 38	NONE	3DCO	0/ 0/ 0.00	9	49 10.8	17.8	214/ 19
A0	353/ 84	NONE	UNCO	0/ 0/ 0.00	26	56 9.5	18.2	227/ 30

Figure 12. Composite Reflectivity with Combined Attribute Table.

1. Default
2. Minimized (Conservative)
3. Squall Line
4. Tropical

The ***default*** adaptable parameter set optimizes algorithm performance for all types of storm events. When compared to the Build 9 TVS algorithm, TDA with the ***default*** parameters produces a much higher POD, meaning that a greater number of tornadic events will be detected (see Fig. 13). The ***default*** settings also result in a much

TVS/TDA Performance

	TVS	TDA (Def)	TDA (Min)
POD	7	46	<5
FAR	8	39	<5
CSI	7	36	<5

Figure 13. TVS/TDA Performance (ETVS not included.)

higher FAR, meaning that a significant number of TVS/ETVS symbols will be displayed for events which are ultimately non-tornadic.

The ***minimized*** (conservative) adaptable parameter set results in the TDA performing much like the Build 9 TVS algorithm. The ***minimized*** parameter set gives a POD of tornadic shear close to 5%, meaning that many tornadic circulations will go undetected. The ***minimized*** setting produces a FAR which is also close to 5%, meaning that if a circulation is detected it is likely significant.

Studies of TDA performance for squall line and tropical events suggest that neither the default nor the minimized parameter result in the best algorithm output. The ***Squall Line*** and ***Tropical*** parameter sets were developed to enhance performance during these types of weather situations. Performance scores were not finalized when this document went to print, but will be available when Build 10 software is released.

TDA Adaptable Parameters Under URC Level of Change Authority (LOCA)

Three additional TDA parameters are under the URC LOCA. The ***Minimum Reflectivity*** is the lowest value of reflectivity required for a range bin to be used in a pattern vector. Unit Radar Committees have the authority to change this value between 0 and +20 dBZ. The default value is set to 0 dBZ. Lower values of reflectivity imply that TDA will process more data, increasing CPU usage. Larger values imply that some circulations well outside the storm core may not be included for processing by TDA.

The ***Maximum Pattern Vector Range*** is the maximum range at which pattern vectors are identified. Unit Radar Committees may adjust this parameter to between 100 and 150 km. The default value is set to 100 km. The ***Maximum Number of Elevated TVSs*** parameter controls how many ETVSs the algorithm can process per volume scan. ***The default Build 10 value for this adaptable parameter is set to zero***, which means that ETVS features will not be identified unless this parameter is changed. (Allowable values range from 0 to 25). The OSF has delegated the authority to change the Maximum Number of Elevated TVSs to the Unit Radar Committee level.

Setting ***Maximum Number of Elevated TVSs*** too low may result in significant circulations aloft going undetected, potentially diminishing lead time during future tornadic events. Setting this number high may result in an excessive number of non-tornadic circulations being detected. Users should consider that the output from the TDA is also sent to NIDS vendors via the Combined Attribute Table. The NIDS vendors provide this data to the media as value-added products. The numerical value used for this adaptable parameter not only controls the ETVS detections seen internally on AWIPS or at the PUP, but also how many ETVSs the media will receive.

Strengths

Velocity processing is more sophisticated with TDA. The algorithm searches for gate-to-gate shear, which is more closely related to tornadic circulations as compared to strong shear that is not gate-to-gate. Multiple velocity-difference thresholds make it possible to isolate smaller regions of shear within broader regions. The algorithm searches ***all*** velocity pairs possessing a reflectivity and velocity above certain thresholds. The Build 9 TVS algorithm only searches for shear within algorithm-identified mesocyclones.

The output from TDA can be more useful in an operational environment. A distinction is made between different types of shears (TVS vs. ETVS, delta velocity calculations), and more information is provided about the base and depth of circulations. The algorithm, through a greater number of adaptable parameters, allows fine-tuning of algorithm performance, resulting in a higher probability of detecting operationally important shear regions.

Limitations

Adaptable parameters need more research. Parameters which work well in one type of meteorological setting may not be as effective in other situations. Use of this output may require a change in operational philosophy. Algorithm performance using the ***default*** settings results in a higher False

Alarm Ratio. Operators are accustomed to a very low False Alarm Ratio with TVS, which implies that any detections are to be taken seriously. A higher FAR with TDA may result in over-warning, or desensitizing forecasters. In addition, little research has been done to date relating the occurrence of tornadoes to Elevated TVSs. Forecasters should use ETVS output with caution until they develop a better understanding of its utility.

Velocity Dealiasing Algorithm Changes to Support TDA

The Build 10 Velocity Dealiasing Algorithm has been changed to eliminate data dropouts which sometimes occur in high shear regions. The algorithm restores velocity data previously discarded by the Build 9 algorithm. ***Operators can no longer use the existence of data dropouts as indicators of high shear regions.*** Also, only very rarely will velocity dealiasing errors align vertically on three elevation scans and cause a TVS false alarm.

Operational Considerations

When a TVS is reported by the new TDA, consider the environmental wind and thermal profile, the signatures position in relation to the storm with which it is associated, time continuity, and the storm's range from the radar.

Beyond about 60 km, the TVS will most likely be triggered by a strong mesocyclone and, as experience has shown, not all mesocyclones produce a tornado. Since the TDA works independently of the mesocyclone algorithm, the detection of a mesocyclone coincident with the TVS may support issuing a tornado warning. If the TVS is adjacent to a strong reflectivity gradient especially near the back of a storm, near a notch on the right rear flank of a storm, or near the tip of an appendage attached to the right rear flank of a storm, then the forecaster should give greater consideration to issuing a tornado warning.

Because of its sensitivity, the TDA shows continuity in time and space. TVS detections for the same storm on two or more consecutive volumes can suggest the validity of issuing a tornado warning. The TDA has identified TVSs nearly continuously on long-lived supercells typical of the Great Plains, especially ones that cyclically produce tornadoes. In the South and the Southeast, tornadoes may be embedded within squall lines. ***There is not enough experience available to comment on the performance of this algorithm when tornadoes occur within squall lines.*** The TDA tends to identify TVSs near the bend in a line echo wave pattern along the interface between warm moist inflow and storm outflow. While many of the TVSs are false alarms, tornadoes do occasionally spin up under these conditions.

Elevated TVSs are routinely generated by the TDA, but naturally do not score statistically as well as TVSs. However, ETVSs may be used as indicators of rotation aloft that could, with sufficient vorticity near the ground, produce a tornado. That is, they can be used to provide better lead times for identifying storms with the potential to produce tornadoes. A second use is to fill in gaps in TVS detections. Sometimes vertical continuity cannot be established between the lowest elevation and higher elevations. Other times ground clutter or range folding precludes measuring high gate-to-gate velocity differences. An elevated TVS may provide the time continuity to give a forecaster confidence to issue a tornado warning. ***One should be cautious about issuing a tornado warning based solely on ETVSs.***

Remember that algorithms serve to provide users with guidance. Ultimately, the decision to issue or not to issue a warning is up to the individual forecaster using all available data, including spotter reports.

New LRM - Anomalous Propagation Removed (APR) Product

Introduction

The Layer Composite Reflectivity Maximum - Anomalous Propagation Removed product (APR, ID# 67) is an 8-data level reflectivity display similar in appearance to the existing Layer Composite Reflectivity Maximum (LRM) products. The APR product does not replace any of the existing LRM products. It is derived from the output of an algorithm which processes base reflectivity, velocity, and spectrum width data with the goal of distinguishing between meteorological returns and returns from ground clutter/AP. The algorithm will generate a Surface to 24,000 ft Layer Composite Reflectivity Maximum product every volume scan with the algorithm-identified ground targets removed (see Fig. 14).

APR Algorithm

The algorithm used to identify and remove clutter was developed at **Lincoln Laboratories,** and is based on the observation that ground targets tend to affect mainly the lowest antenna tilts, and are typically associated with low radial velocity and low spectrum width.

The algorithm separates the atmosphere into three regions based on distance from the RDA, and altitude above the surface. A different clutter removal technique is applied to each region, based on known observations of the appearance and location of clutter.

The ***Omit All*** region is defined as that portion of the atmosphere within 45 km of the RDA, and below 1 km in altitude. All targets in the Omit All region are considered clutter and are removed (see Fig. 15).

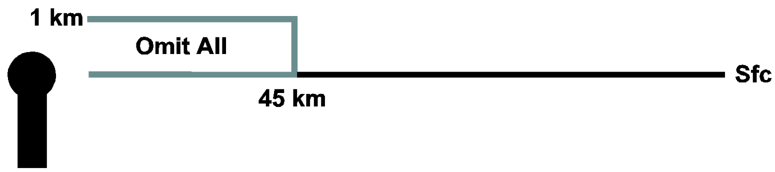


Figure 15. Omit All Region.

The ***Accept If*** region is defined as that portion of the atmosphere within 103 km of the RDA, at 0.5° and below 3 km in altitude, and not within the Omit All region. A target in the Accept If region is

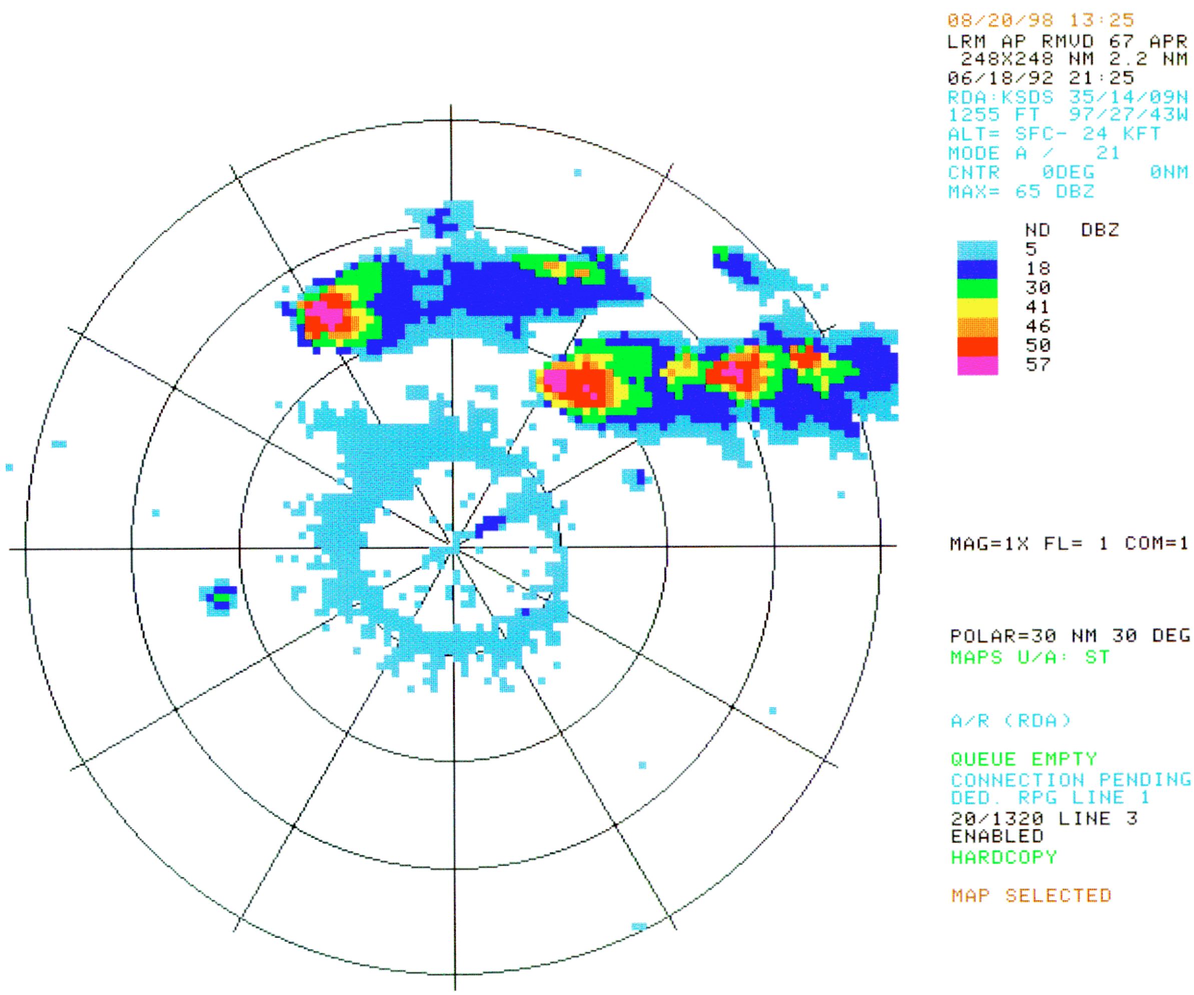


Figure 14. LRM-AP Removed product.

accepted if its velocity is $\geq$ 1.0 m/s ***and*** its spectrum width is $\geq$ 0.5 m/s. Essentially, a target in this region is assumed to be clutter, but it will be ***accepted*** as being meteorological ***if*** movement is indicated by either velocity or spectrum width data (see Fig. 16).

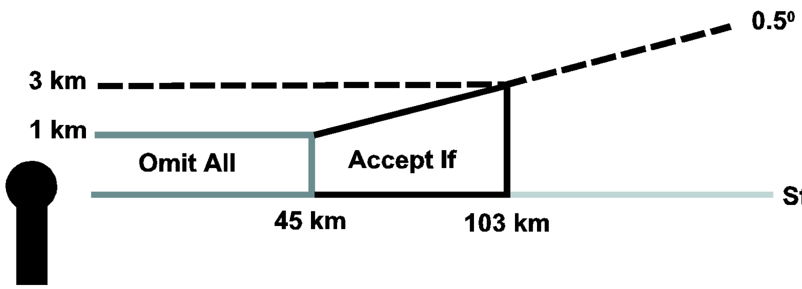


Figure 16. Accept If Region.

The ***Reject If*** region is defined as that portion of the atmosphere within 230 km of the RDA, below 5° in elevation, and not within either the Omit All or Accept If regions.

A target in the Reject If region is rejected if it possesses a velocity <1.0 m/s and a spectrum width < 0.5 m/s. Essentially, a target in this region is assumed to be meteorological, but it will be ***rejected*** as being clutter ***if*** little or no movement is indicated (see Fig. 17).

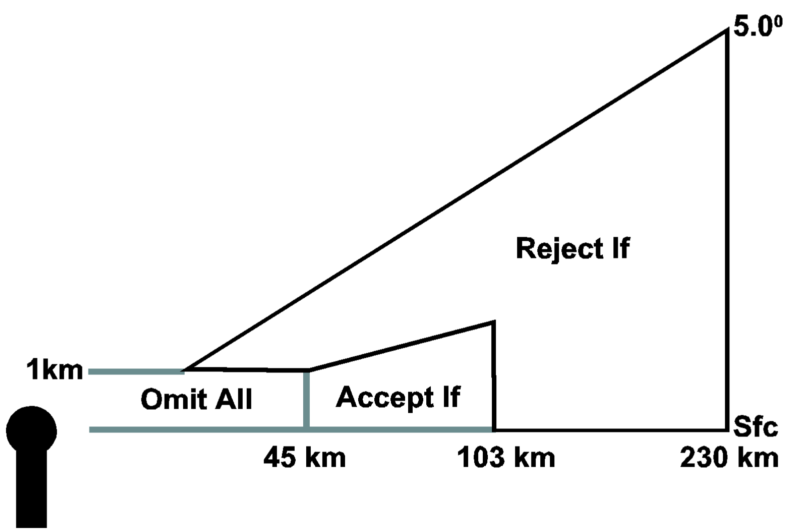


Figure 17. Reject If Region.

Strengths

The APR algorithm attempts to distinguish weather targets from clutter targets.

Limitations

The algorithm works best if traditional clutter filtering is applied before the algorithm begins processing data. The algorithm assumes ***all*** low level data within 45 km is clutter, which may result in valid data being dropped from the product. Current adaptable parameter values may not be the optimum settings, and further testing may be needed to enhance algorithm performance.

Build 10 Enhancements

Ability to Select the Lower Boundary Height of the Lowest LRM Layer

Introduction

Operators may now specify the depth of the lowest layer of the Layer Composite Reflectivity products by changing the base of the lowest layer. The top of the layer remains fixed at 24,000 feet MSL. The authority for modifying the lower boundary height is at the Unit Radar Committee Level. Changing the lower boundary height of the lowest LRM layer affects both the LRM and LRA products, but not the new LRM-AP Removed product (see Fig. 18).

Strengths

Operators now have the capability to vary the thickness of the lowest layer on the LRM and LRA products. The ability to raise the lower layer boundary may assist forecasters in the identification of pulse type storms and first echoes, and may also help differentiate real echoes from non-precipitation echoes.

Limitations

With the ability to raise the lower layer boundary, the operator is reducing the number of tilts used to generate the lowest layer composite. The top of the lowest layer remains fixed at 24,000 ft MSL. As with all products, the lowest layer of the LRM is susceptible to non-precipitation echoes.

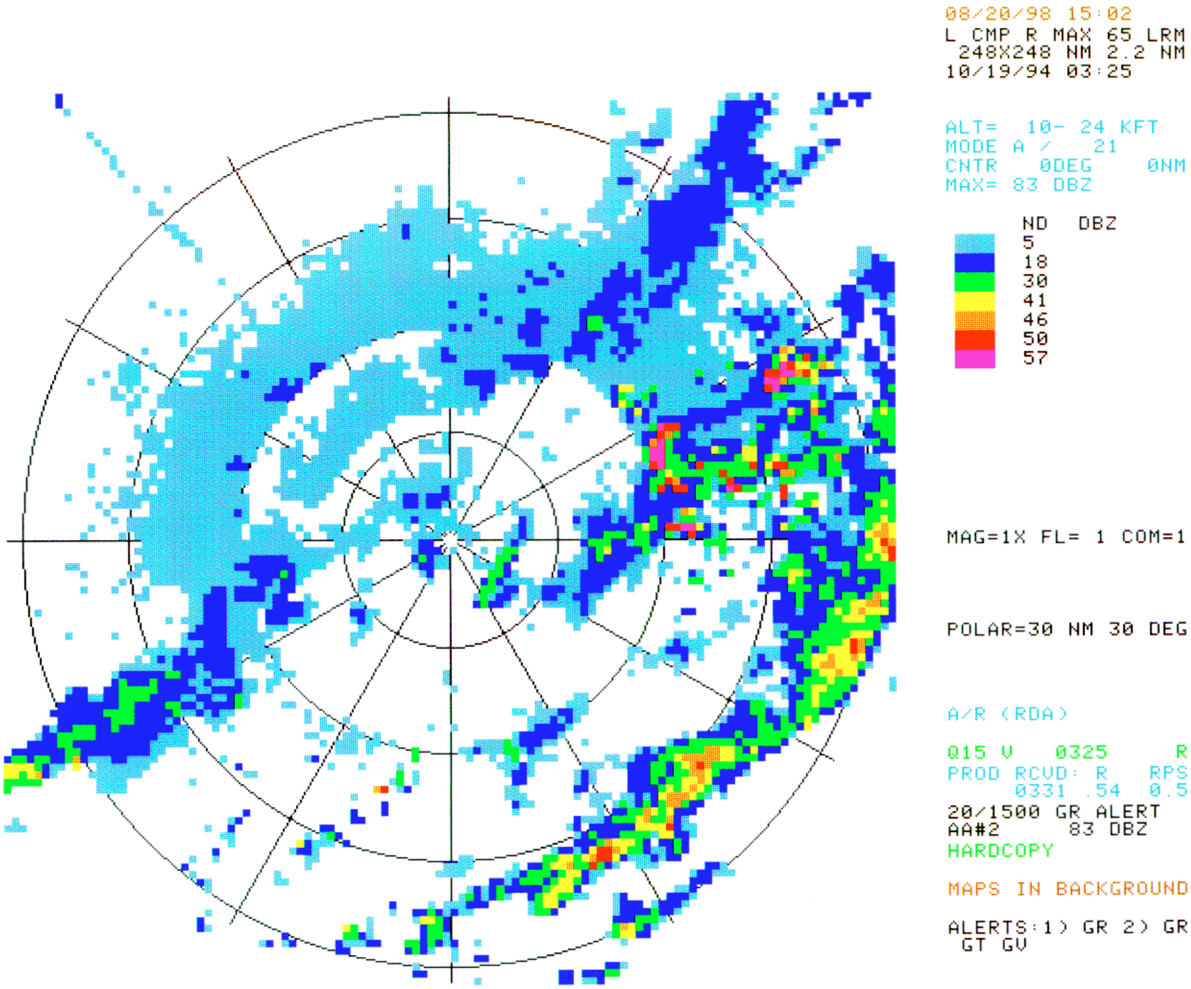


Figure 18. LRM lowest layer product with base changed to 10,000 ft MSL.